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THE ESSENTIALS OF SMALLPOX VACCINATION.

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THE VACCINATION REACTION:

When potent vaccine virus is applied to the derma, irrespective of the method used for penetrating the epidermis, a reaction will take place, reaching a maximum which may be observed in from 1 to 10 days, depending on the degree of immunity of the subject. *Absence of this reaction indicates that the virus is incapable of protecting against smallpox, and not that the subject is immune.* Any one of the forms of this vaccination reaction, to be described below, is evidence of a successful vaccination.

If the subject has never been immunized by smallpox or by previous vaccination, the reaction will manifest itself as a primary *vaccinia*. A *papule* appears at the inoculation site on the third or fourth day following the vaccination. This becomes vesiculated on the next day, the *vesicle* being surrounded by a narrow red margin or *areola*. This vesicle increases in diameter at the rate of approximately a millimeter a day. About the seventh day, the skin outside the areola begins to turn red; and this *area* of redness rapidly extends until the ninth or tenth day, when the maximum diameters of vesicle and area are reached. After this day, the area rapidly fades and the vesicle becomes brown and crusted, though still surrounded for some days by a narrow areola. If kept dry, the *crust* will separate in approximately three weeks from the day of vaccination, leaving a red *scar*, which becomes white in several months. Accompanying the rapid development of the area (seventh to tenth days), the axillary lymph nodes are usually swollen and tender, and fever and headache are generally present. All these symptoms abate promptly when the maximum of the local reaction is reached.

If the subject retains some degree of immunity, either through previous vaccination or an attack of smallpox, the reaction will be accelerated in development, shortened in time, and decreased in severity. The papule will appear earlier, the vesicle will be smaller, and the area will be less extensive at the maximum of the reaction, which may occur at any time from the fourth to the eighth day. In this event the reaction is considered a *vaccinoid* (accelerated reaction, or secondary *vaccinia*).

If the immunity is very high, the acceleration may be so great that the reaction consists only of a papule and areola with the maximum diameter in from 12 to 60 hours after vaccination. In this case there is neither vesicle nor area, and the reaction is designated *reaction of immunity* (immediate reaction). The time element of this reaction is of prime importance. If the papule and areola do not appear until the third day and *there is no vesiculation*, the reaction is not that of immunity but is due to an impotent virus, and the vaccination should be repeated with a fresh lot.

NECESSITY FOR KEEPING VACCINE ON ICE.

The expiration date on a package of vaccine virus indicates its expectancy of potency under favorable conditions. Vaccine virus can not be kept too cold; it deteriorates rapidly even at room temperature. The freshest possible vaccine should be obtained; and this can be done by arranging for small and frequent shipments. The packages should be kept in water-tight containers in constant contact with ice. Large quantities may be placed in metal boxes, small quantities in fruit jars. For use in the field, large quantities should be transported in ice-cream freezers, small quantities in rubber-stoppered test tubes, packed with shaved ice in the inner compartments of vacuum bottles.

PREPARATION OF THE SITE FOR VACCINATION.

The skin of the upper arm in the region of the depression formed by the insertion of the deltoid muscle should be thoroughly cleansed with acetone on sterile gauze or cotton and wiped dry. Acetone is suggested as a cleansing agent rather than alcohol for the following reasons:

1. It is a more efficient cleanser.
2. It is cheaper.
3. It is not denatured with substances which may possibly affect the vaccination result.
4. It evaporates more rapidly.
5. Approximately 200 vaccinations recently performed after the use of acetone and alcohol on alternate subjects resulted in more successful vaccinations with acetone than with alcohol.

METHODS OF VACCINATING.

1. *The method of incision or linear abrasion.*—As practically all the packages of vaccine virus distributed in this country contain sterile needles, this is the method of choice for occasional vaccinations.

In each package of capillary tubes there will be found a perforated rubber bulb with a diaphragm across the interior of the neck. Push

an unbroken capillary tube through the neck of the bulb until about half of the capillary tube appears beyond the bulb. Break the tip which has been pushed through and withdraw the tube until the broken end lies in the neck of the bulb. With sterile gauze, break the other tip of the capillary tube and drop the contents on the spot to be vaccinated by squeezing the bulb with the finger over the perforation.

The underside of the arm is then grasped with the vaccinator's left hand, in order to stretch the skin where the virus has been dropped. This tension is maintained while the virus is being inserted. With the point of a sterile needle pressed through the drop of virus, "*a very slight scratch, not exceeding the eighth part of an inch*" (Jenner), is made down the arm. With the side of the needle or the flat end of a sterile toothpick, the virus is then gently rubbed across the scratch for at least 15 seconds.¹ The scratch should penetrate the epidermis, but not draw blood. The friction across the scratch may cause a slight oozing of blood-tinged serum, but this should not be sufficient to wash the virus out of the scratch.

2. *The drill method.*—In the drill method the epidermis is perforated by a small drill with a sharp cutting edge 2 mm. in width. The drill is made of carbon steel and the tip can be sterilized without affecting the temper of the cutting edge by dipping into alcohol and burning off the surface. The drill method is preferable for the rapid vaccination of large groups, because of the uniformity of perforation of the epidermis, which results in the maximum exposure of the derma to the virus with the minimum resulting lesion. The method is particularly advantageous where vaccine in vials can be used.

If in capillary tubes the virus is prepared for insertion as previously described, but is not dropped on the skin until after the derma has been exposed. The skin is tightly drawn and the drill pressed against it perpendicularly. A single rotary turn is then made without altering the pressure. This will detach a small flake of epidermis, which should be brushed off with the edge of the drill. This exposes a circle of derma about 2 mm. in diameter and, if skillfully done, should cause no bleeding. The virus is dropped on this circle of exposed derma and rubbed in with a sterile toothpick, as described under the method of incision.

If the number of persons being vaccinated is large enough to warrant the expenditure of all the virus in a vial vaccine container at one clinic period, the vaccine may be transferred directly to the arm with the sterile toothpick.

¹ This recommendation is based on the results of a series of tests with different viruses.

NUMBER OF INSERTIONS.

Multiple insertions should be used under the following conditions:

1. In case of exposure to smallpox.
2. In case of failure of previous vaccinations.
3. In case there is any doubt as to the full potency of the virus on account of possible adverse conditions of transportation or storage.
4. In case the subject is not likely to return for revaccination in the event of failure.

When multiple insertions are used, they should be made not less than 2.5 cm. apart. A capillary tube should be used to each insertion.

PRECAUTIONS.

The vaccination site should not be exposed to direct sunlight until dry. *Dressings are unnecessary and are harmful if permitted to remain on the arm.* The small vesicles produced by either of the above methods are reasonably tough and will dry without rupturing unless macerated by the excessive heat and moisture present under a vaccination shield or other nonmobile covering. This maceration is not prevented by the presence of openings in the vaccination shield:

All vaccinations should be observed at the end of 7 and 11 days, and revaccinations should, in addition, be observed after 48 hours, in order to detect a possible reaction of immunity. *The vaccination of persons who have been exposed to smallpox should be considered successful as soon as this reaction of immunity appears.* Reporting for observation may, however, be more readily insured by attaching a small piece of adhesive tape, stamped with the observation date below the vaccinated area.

Small insertions are insisted upon, because the diameter of the lesion is dependent upon the amount of epithelium removed, and the rapidity of healing is dependent upon the size of the lesion.

THE VACCINATION CERTIFICATE.

The result of the vaccination should be indicated on the vaccination certificate by noting the day of greatest extent of redness. This may be done conveniently by checking the day on the following diagram:

	Reaction of immunity.			Vaccinoid.				Vaccinia.			
Days.....	1	2	3	4	5	6	7	8	9	10	11

Encircle the number of the day after vaccination on which the greatest extent of redness was observed.

The number of successful insertions, the lot number of the virus, and the expiration date should also appear on the certificate.